

# Staged Magnetic Compression of FRC Targets to Fusion Conditions

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# Helion Energy

## Project Lead

20 Tesla ARPA-E Experiment

40 Tesla Reactor



## Existing Facilities and Expertise

12 Tesla Experiment Upgrade



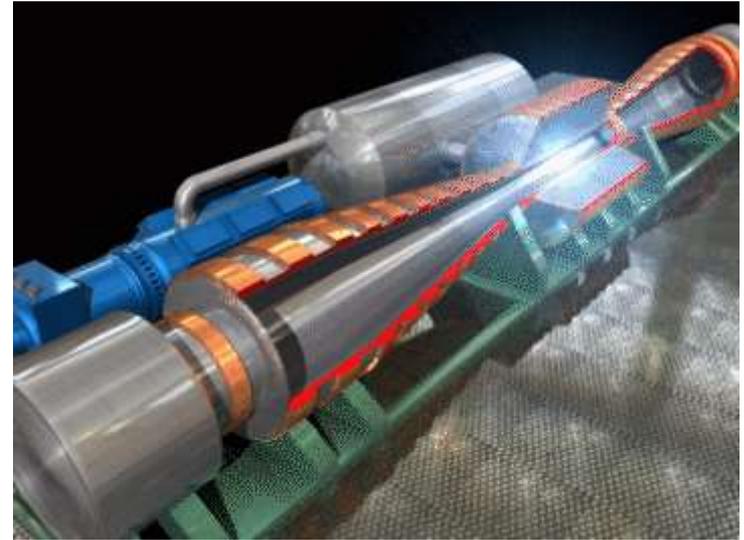
## Theory and Code Development

Implement MHD and Particle Codes

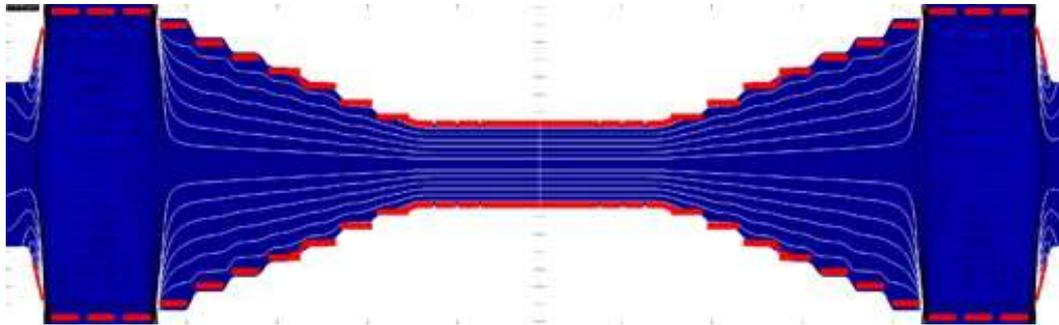


# The Fusion Engine

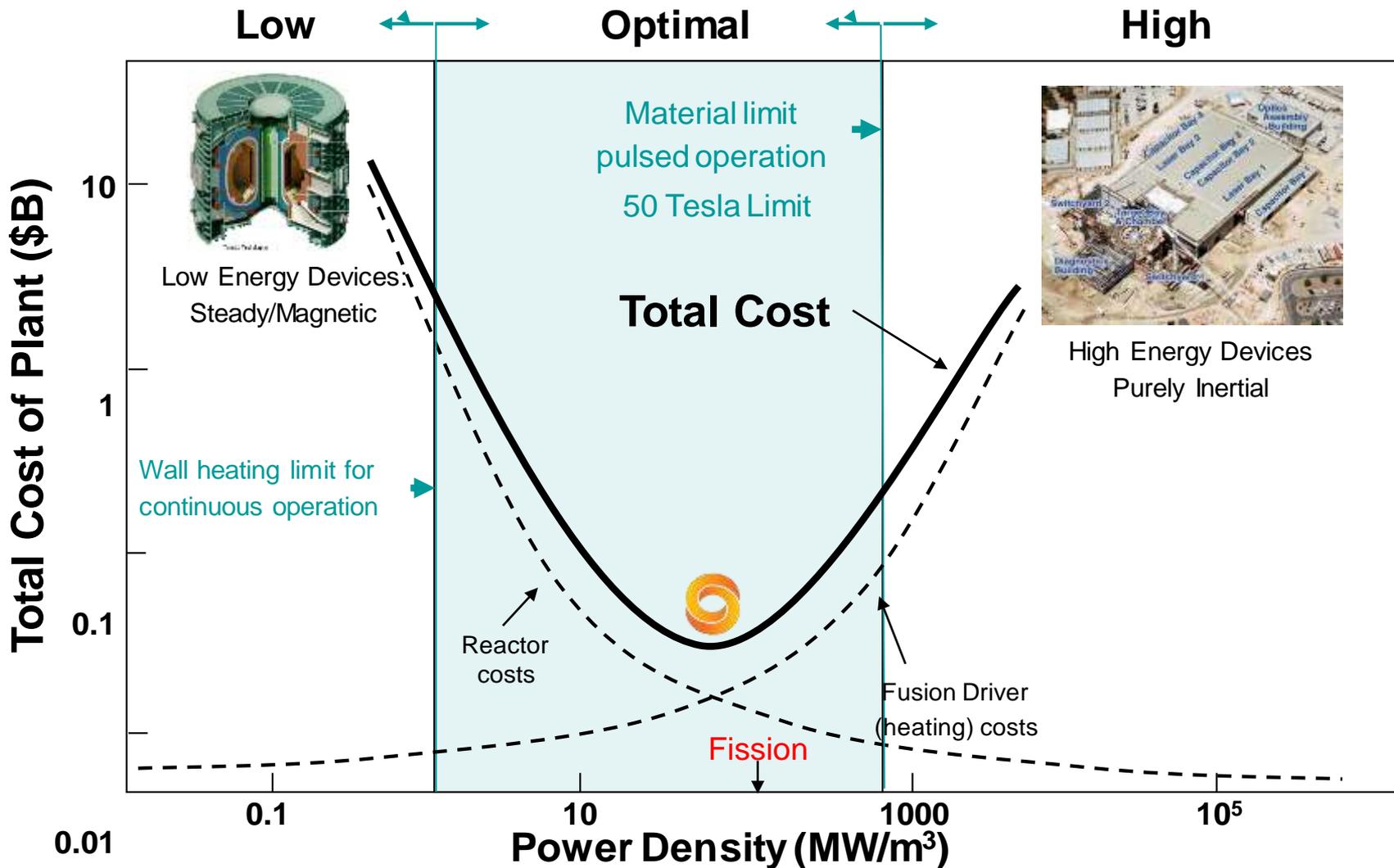
1. **Formation** – Two FRC plasmoids are dynamically formed by sequential field reversal
2. **Acceleration** – FRC plasmoids are accelerated to high velocities ( $>300$  km/s)
3. **Merging** – Two supersonic plasmoids collide and merge converting kinetic into ion thermal energy
4. **Compression** – FRC is adiabatically compressed to fusion temperatures
5. **Energy Generation** – Spent plasma, fusion ions, and neutrons are converted to energy



*Artist's animation of the FE*



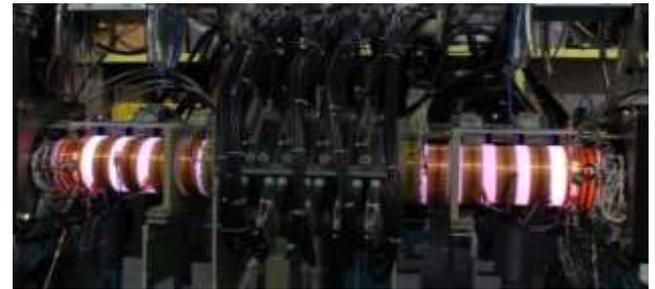
# Energy Density



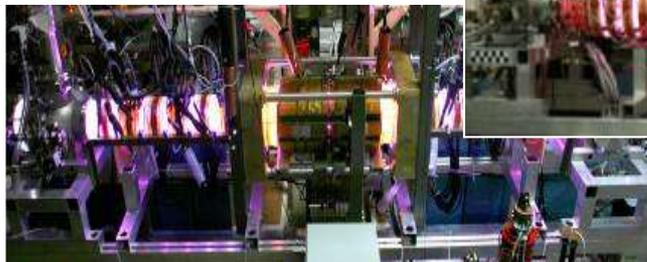
# Key Approach

## Developed to be economically competitive

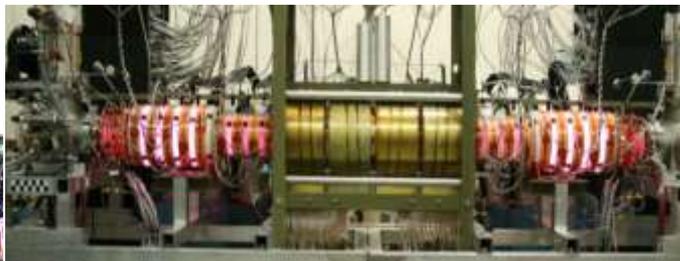
- 50 MW - rapid development, modular power markets
- Direct fusion particle energy to electricity- output efficiency
- Magnetic/Inductive compression – input efficiency, massless, and  $< \$0.03/\text{MJ}$



# Technology Demonstrators



IPA



IPA-C



Grande

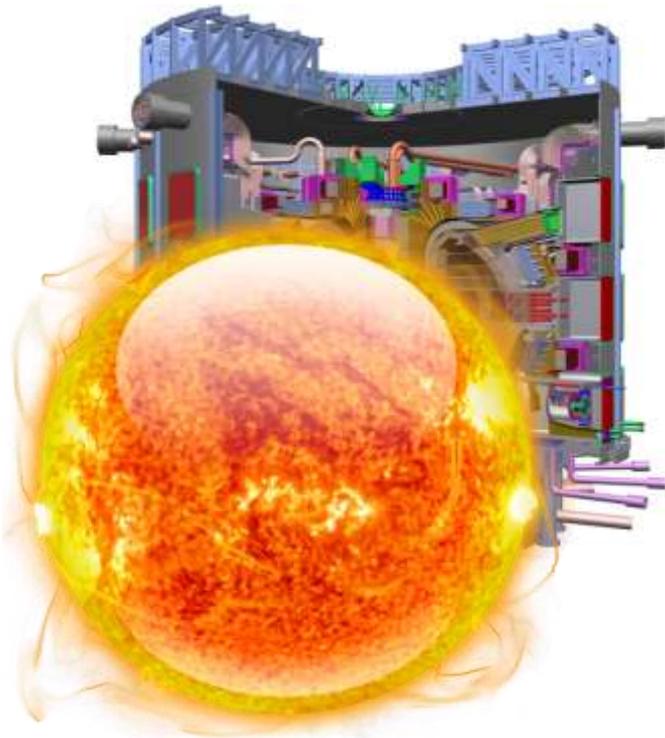
LSX, PhD – Full Scale & Stability  
IPA – Merging  
IPA-C – Heating and compression  
Grande – High field operation

VENTI  
FEP  
FEP-G

Millisecond lifetime  
Merged FRC confinement  
1 keV D ions  
5+ keV D ions

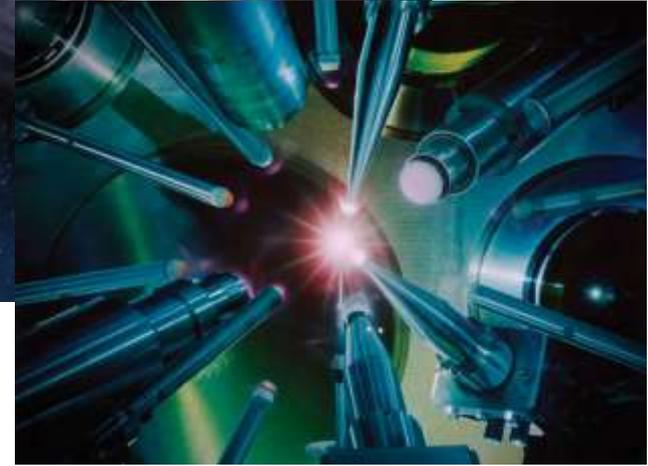
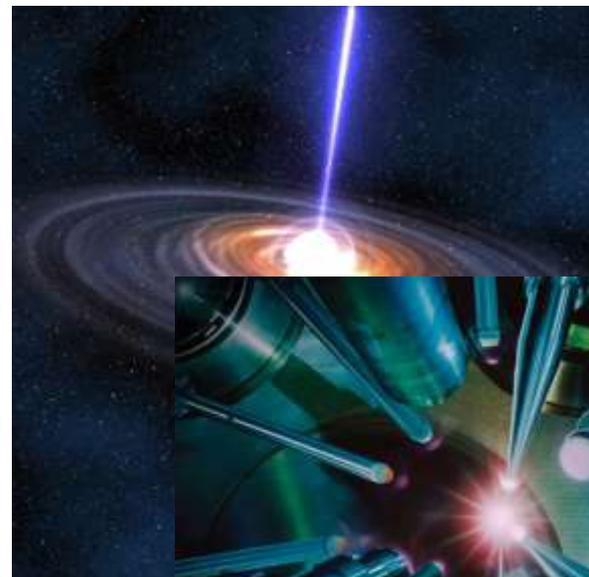
## ARPA-E

12 Tesla Compression  
20 Tesla Compression  
40 Tesla Reactor



# Too Big

Fundamentally large scale



# Too Hard

Fundamentally inefficient



# Just Right



Scalable, Low Cost, and Efficient